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Guidelines for improving user/dp relations in the information processing environment.

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GUIDELINES FOR IMPROVING USER/DP RELATIONS IN THE INFORMATION PROCESSING ENVIRONMENT

by

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LIST OF ACRONYMS

1. DB - Data Base
2. DBMS - Data Base Management System
3. DP - Data Processing
4. ICIS - Insurance Claims Information System
5. LRP - Long Range Plan
6. MIS - Management Information Systems
7. OSHA - Occupational Safety and Health Act
8. SAFER - Severity and Frequency Evaluation Reporting
9. SINS - Safety Information System

Abstract

ABSTRACT

Management information systems (MIS) within the organization are the means through which the corporation manages its fundamental, vital, and most valuable resource--data! In order to gain the necessary perspective of the proper importance of MIS within a corporate organization, one need only ask the question: "How many companies could function without information processing?" Participation in the MIS development process should not be regarded as an added burden that detracts from the business operations but rather as an inherent duty and responsibility.

The scope and content of this thesis is intended to examine the relationships that exist between the MIS personnel and the user community within the corporation. Since it is the user who ultimately determines the success or failure of the information system, these relationships are of critical importance. This text presents general guidelines for improving user/DP relations in the information processing environment of the organization.

User management can define their information needs; the MIS analyst cannot. Therefore, the user must be directly involved in planning and controlling changes in managing their business functions. Developing a new information system represents such a change--changing the way in which a given function was being

performed. Through involvement, resistance to change is minimized; system development efforts are less hectic. The best systems result from the user conceiving and/or contributing to the solution, because, in the end, it must be his sytem. Successful systems require meaningful involvement through active user participation (interaction). Only when the ultimate user of the system makes the relevant decisions will the system be truly his.

By working together, the expected results are not forever in the grey area. There are no surprises for top management, user management, and MIS management. There are no misunderstood objectives or unclear specifications. There are no unexpected commitments and no gaps between promises and results.

The manager of today must continually re-examine the patterns of the management process with the computer as part of the mix. Evaluating the economic feasibility of the alternatives is a responsibility that must be shared by both the user and MIS management.

In summary, in order to assure the development of effective information systems, user and MIS personnel must work together to conceive ways to best manage and use the organization's informational assets. This requires investigating alternatives, understanding each other's roles, and communicating at all levels of system development. The general guidelines presented in this

thesis can provide a framework within which an organization can seek to improve the relationships between the users and the MIS systems personnel.

1.0 Literature Search and Related Background

Data processing as a career began growing so rapidly in the early seventies that many colleges and universities found themselves severely understaffed and unable to focus much attention on teaching anything other than introductory courses in data processing. As some developed more advanced courses in systems analysis and programming, it became apparent that incorporating the use of the computer in more traditional course offerings was inevitable - and justified. Not only did the data processing specialists - systems analysts and programmers - need training, but students destined to become managers in the functional business areas of accounting, finance, marketing, personnel, and production needed exposure to the business environment greatly affected by the use of computer-based information systems.

Most introductory data processing texts emphasize the technical orientation - what the computer is, what it can and cannot do, and how it operates. This knowledge of hardware and programming concepts is both valuable and necessary. But management must be exposed to the broad impact that computers have had historically, are currently having, or are expected to have on business managers and their work environment.

Literature Search and Related Background

Many authors have addresssed the subject of managerial and user orientation to information systems. Perhaps the most important topic related to this subject, and certainly one of relevance in the dynamic field of information processing, is the critical importance of the communication between the systems development and support staff and the user community within the organization.

Chapters 1.0 and 2.0 of this text are basically introductory in nature and serve to set the stage for a discussion of user/DP interaction within the information processing environment of the organization.

Chapter 3.0 focuses attention on the factors affecting user/DP relations in the information processing environment. Donald H. Sanders' Computers and Management in a Changing Society [13] provides relevant background for a discussion of the information processing revolution and the implications of rapid technological change with respect to the business environment and society in general.

Chapter 4.0 draws upon several sources to provide a discussion of the techniques for improving user/DP relations during the most critical phases of system development - initial conception and system design. Textbooks by James Martin [8,9], Edward Yourdon [15], and Gordon Davis [3] serve to provide useful and workable techniques for improved user communications, especially in data

base and on-line environments. The service analysis approach is addressed in the application of data base planning techniques from the Service Analysis Handbook by Performance Development Corporation [14]. Various articles from Infosystems magazine provide the background for a presentation of current issues and approaches to data analysis as an integral part of the system design activity. User/DP relationships are given special attention because of the critical importance these have on the successful implementation of management information systems, especially in the data base environment. These relationships could undoubtedly undergo changes as questions of privacy, security, and provincialism of data are raised as a result of the changing technological environment.

The organization of this text is basically structured to move from the general to the specific. The reader is introduced to the topic through the general discussions of the various factors affecting the relationships between the MIS department and the corporate user community. Specific guidelines for improving user/DP relations are presented and supported through background discussions and examples of (1) the data base decision, and (2) the design of a corporate safety information system. Note, however, the scope of this thesis is not intended to include detailed data base or system design considerations; rather, examples are used to present certain techniques for incorporating the system users into the design process.

2.0 Definition of Problem

The scope and content of this thesis is intended to identify and discuss the factors affecting user/DP relationships both within and outside the organization and to provide the systems designer with general guidelines and techniques for improving user relations in the information processing environment.

Given the current environment in information processing, the following are the major questions to be addressed:

- What corporate and societal issues are prevalent in the rapidly changing technological environment which impact on the user/DP relationships?
- What are the future implications for system development in such an environment?
- How are user/DP relationships affected by the corporate transition to data base technology?
- What techniques can be applied to improve user communications during the system development phase?

Definition of Problem

2.1 MIS - The Concept

Before one can begin to discuss the relationships between users and the MIS professionals (analysts, programmers, etc.), it is important to understand the concept of "management information systems". MIS can be broadly viewed as the delivery of information to management. The complexity of the MIS concept arises in attempting to define what is meant by "management" and "information". Analysis of these terms points to the fact that MIS is a multi-dimensional concept.

For purposes of this paper, management is defined as the process of achieving organizational objectives through the efforts of people within the organization. Three important points of this definition should be emphasized. First, management is a process - i.e. management consists of a number of interrelated steps or functions which, when satisfactorily performed, lead to the achievement of goals. The second point is that without the establishment of specific objectives, the effective practice of management is most difficult, if not impossible. The third point is that the successful practice of management involves people working together in harmony to achieve desired results. It is this third point which this text addresses; for it is the combined efforts of both the information systems analysts and the users which determine the successful implementation of an information system.

Definition of Problem

The availability of quality information is, of course, a requirement for an effective organization. Quality information can support good decisions; good decisions should lead to effective performance of managerial functions; and effective functional performance should lead to the attainment of organizational goals. The dynamic technological environment in information processing promises continual improvement of the quality of information; this fact has important managerial implications. Effective computer usage can certainly improve the effectiveness of the managerial functions of planning, organizing, staffing, and controlling. But it must be emphasized that computers do not "make decisions". Rather, they follow programmed decisions made by earlier managers, analysts, and programmers.

Data should be regarded as a vital corporate resource which must be organized to maximize its value. In a large complex information processing environment the two-part question "What do we have and where can we find it?" becomes a matter of increasing concern. The management of complex application systems is a difficult and time-consuming task. Not only must a system be designed in the most cost-effective and time-effective manner, but considerations for the on-going support of the system as well as effective use and management of data and system resources in the corporation must be addressed. The systems designer steers a delicate course through compromises.

Definition of Problem

The trend toward systems that serve higher and higher levels of management is forcing us to move away from the notion of data processing to that of information processing. Data is transformed into information through infusion of purposeful intelligence [5]. Information is data that has been culled, analyzed, integrated, and presented on a selective basis and in a format that helps the user gain a better understanding of what is going on. This leads to better decision making.

To adequately describe MIS as a concept, four different but related elements must be considered [7]:

- Management processes/perspectives
- Transaction data aggregation
- Information correlation
- Information delivery methodology.

Management Processes/Perspectives

To adequately manage an organization or business, one must analyze it from a series of managerial perspectives. Although greater emphasis or unique requirements may be placed on some of these processes by specific line or staff managers, when specifically defined within a given organizational context, these major

processes should permeate, to some degree, upward throughout the managerial hierarchy (as shown in Exhibit 1, Figure A, page 13). Futhermore, upper level management should be concerned with all of the processes to fulfill their strategic management responsibilities. Consequently, the primary requirements of an MIS structure is to support these major processes as they relate to each level of line and staff management.

Transaction Data Aggregation

Most relationships between an organization and its customers/suppliers culminate in some type of transaction. In order to function, the organization requires capabilities to collect, categorize, validate, prove, track, and report those transactions. In addition to their basic record-keeping functions, these detail oriented transaction processing capabilities provide one of the bases of management information. However, to be useful from an MIS perspective this mass of data must be aggregated along lines delineated by the major management processes (as shown in Exhibit 1, Figure B, page 13).

Information Correlation

As the requirements of those higher in the management hierarchy are considered, there is an increasing need to make correlations between the data aggregations supporting the individual processes, and to make correlations with relevant external data. Exhibit 1 (Figure C, page 13) represents the need for information correlation as one progresses through the management hierarchy.

Information Delivery Methodology

This final element deals with the format in which information must be presented to users. There must be provisions for three primary mechanisms (shown in Exhibit 1, Figure D, page 13):

- Transaction detail - Mechanisms must be provided to report the mass of transaction data to meet the needs of the organization's accounting operations, proof and control, and basic auditing functions.

- Structured MIS - Provision must be made to periodically formulate and correlate data in a consistent and predetermined manner to support the various on-going control mechanisms implemented to support the various management processes.

- Analytical MIS - Provision must be made to correlate information in an unstructured form capable of supporting modeling, simulation, etc. in an undefined and continually changing format - ie. an environment geared toward supporting management gaming and strategic forecasting techniques.

Elements of MIS Within the Organization

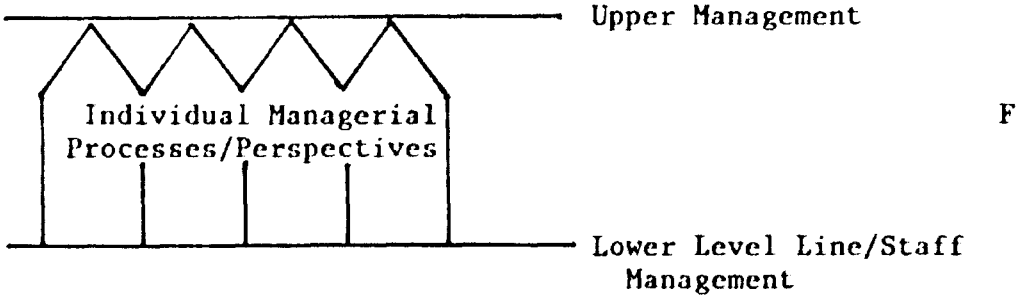


FIGURE A

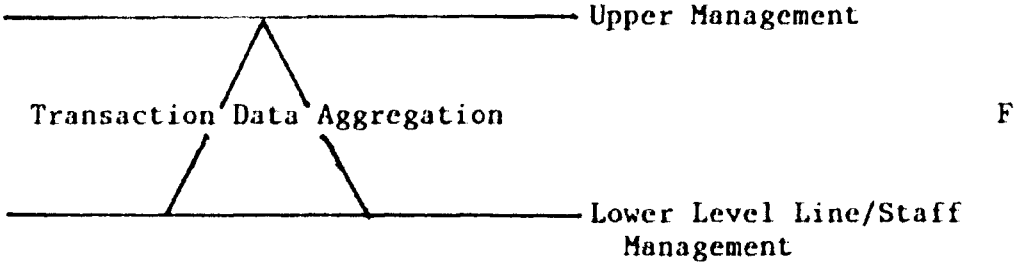


FIGURE B

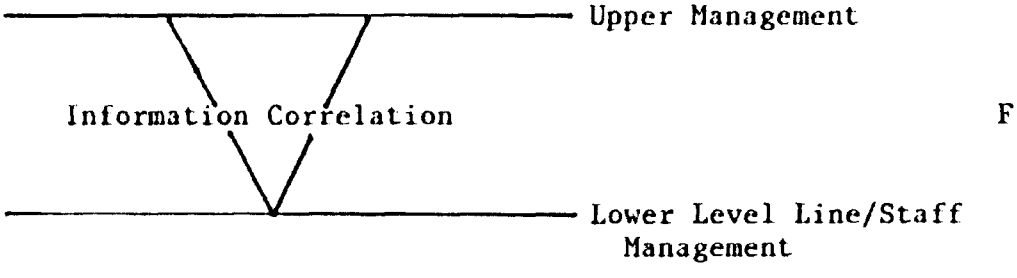


FIGURE C

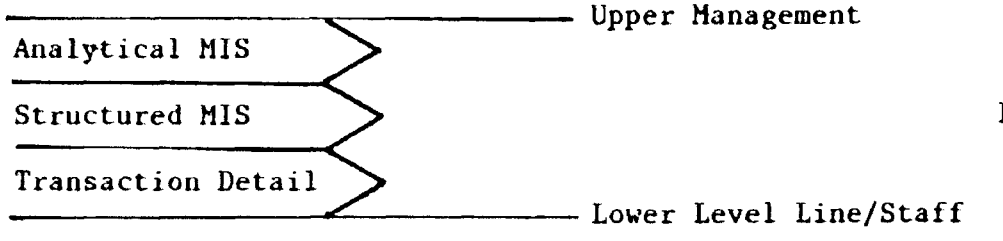


FIGURE D

3.0 Factors Affecting User/DP Relations

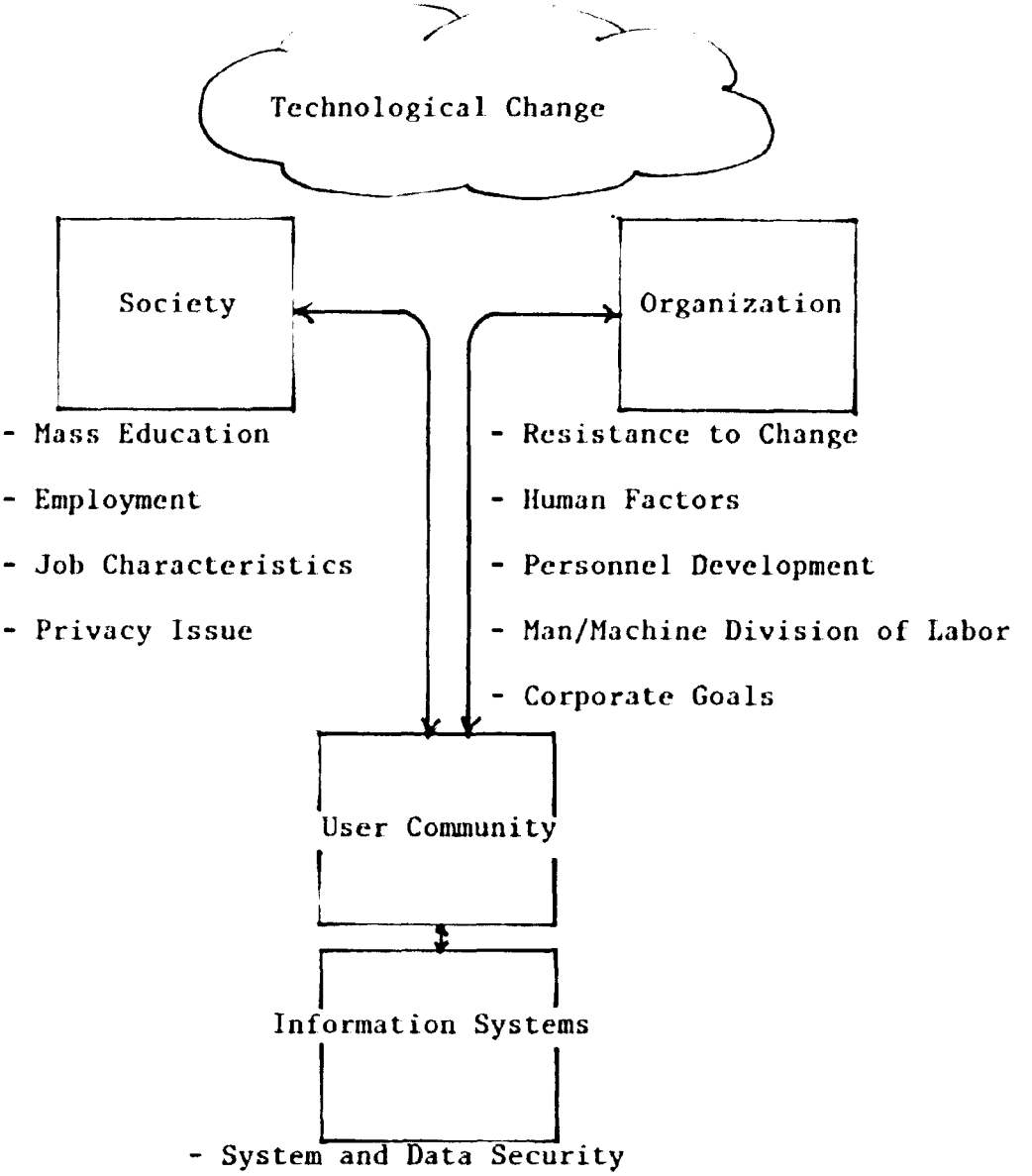
Though the word "revolution" tends to be overworked, when applied to forces that bring about significant social, political, and economic changes, the term is quite appropriate. In the Industrial Revolution, new machines that became agents for great social change were built, and now new scientific and technological knowledge is again injecting revolutionary forces into society. In fact, it is likely that the scope and pace of the environmental changes occurring today are unprecedented in history. The basic challenge to corporate leaders is to foresee and manage (and not be swept along by) the flood of changes facing their organizations, and to do this within a democratic framework for the benefit of society as well as for the benefit of customers, employees, and stockholders.

The implications of rapid scientific, social, political, and economic changes are clear--the business manager must be prepared to make continuous readjustments in his plans. He must make more and better decisions about both new and existing products because of their shortened profitable life span; he must be prepared to face increasingly aggressive foreign and domestic competition; he must make important financial decisions. Furthermore, these decisions must be made within a time span that is constantly

shrinking. To compete profitably in the future will, therefore, require information of the highest possible quality. The computer and data base technology are recognized to be valuable tools that can provide the needed information to managers who must operate in a dynamic environment. But to successfully utilize these tools, one must establish a climate of trust between the systems analyst and the user in order to provide effective and efficient interaction and to assure the channels of communication are open.

The purpose of this chapter is to identify the factors (societal, organizational, and system-oriented) which affect, either directly or indirectly, the relationships existing between the users and designers of information systems. Exhibit 2 (page 16) presents an overview of these factors in light of the "clouds" of technological change prevalent in information processing.

Factors Affecting User/DP Relations



3.1 Societal Factors

The use of computers for organizational information systems affects the quality of life outside the organization and, therefore, has implications for society in general. This section addresses four key topics which management should recognize with respect to their impact on the corporation as well as within society.

3.1.1 Mass Education

Rapid environmental changes create the need for better information; revolutionary changes in computer technology make better information possible; and since traditional methods are often inadequate, revolutionary new systems must be developed to employ the tool to satisfy the need. As might be expected, however, problems of adjustment are being encountered. In the wake of technological change, mass education is part of our social picture and is a leading contributor to the spiraling change [13]. Why? Because education leads to knowledge; knowledge creates the tools that can lead to higher productivity and rising standards of living; and higher standards of living enable man to devote more time to education. Thus the cycle begins anew, but at a progressively higher level. A better-educated population is potentially more productive, is more mobile, and will have more leisure time and more money to spend in the future. There is also a tendency for some well-educated workers to place professional standards above loyalty to and the values of the organizations which employ them. Top executives will have to adjust to accommodate and motivate a more independent type of subordinate in the future.

From a somewhat different perspective, the importance of education can be recognized within the organization as it relates

to both the MIS department and the user community. Continual advancements in computer technology (hardware and software) create the need for on-going education and training for the MIS professionals in order to assure and maintain high quality, technically competent systems personnel. Equally important is the need to educate the information system users. Through carefully planned training programs, seminars, and especially one-to-one user/analyst sessions, the organization can greatly benefit from the improved working relationships. Internal education should be geared toward helping the users understand and overcome their fear of the mechnical monster called "computer".

3.1.2 Changing Patterns of Employment

The increased use of computers for clerical processing tasks has displaced employees who perform these duties. On the other hand, the computer industry has created new jobs e.g., programmer, systems analyst, computer operator, etc. The clerical jobs being displaced have generally been menial, repetitive, and uninteresting. The new jobs are generally well-paid and challenging. And while the clerical jobs used fairly low-level, minimally trained personnel, the newly created jobs require education and training at a fairly high level.

Predictions have been made that management information systems would have an employment impact on middle managers by reducing the need for them [3]. An information system might reduce the need for middle managers who act as filters and communicators among organizational units. Or perhaps the middle manager's job would be reduced in scope as information/decision systems make it possible for more decisions to be made at higher levels. There may be a trend in this direction; it is, however, not as evident as is the impact on clerical jobs. The reason may be that a large proportion of the middle management functions is not programmable. Personnel decisions, leadership and motivations, opportunity search, and other such duties still need the human touch.

3.1.3 Changing Job Characteristics

A potential danger in computer-based systems is that the computer will result in machine-paced clerical and managerial operations. The clerical employee is paced by the "demand" for prompt input of transaction data; the manager is paced by the system "demand" that decisions be made within a specific time period.

Management information systems are most efficient if standard methods and procedures are used. This concept extends to management levels for analysis of decisions, planning, and control.

The computer-based MIS not only is a force in standardization, but is changing the environment for decision making. Also changing is the amount and location of power in organizations. Control of information resources represents an element of power similar to control of cash and other organizational assets. The use of distributed data processing and local files decentralizes power based upon information resources. The use of data base systems centralizes certain types of information power even though access is broadened.

3.1.4 Reduction in Privacy

The existence of data bases has added a new dimension to the problem of privacy, a problem to be found within organizations as well as within the larger context of government and society. Within an organization, the problem is that of general access to files that were formerly more or less unavailable except to the part of the organization which maintained them. After the data base is developed, not all persons in the organization should have free access to it, because of the internal organizational consideration based on "no need to know" and also because of the societal consideration that data furnished to an organization was provided for specific purposes and should not be available for unrelated purposes except by permission of those concerned.

The privacy problem of a data base in a single organization is compounded when organizations form networks to exchange information. The problems of privacy related to both public and private data bases have prompted legislation at various levels of government and in various countries [3].

3.2 Organizational Factors

The organizational framework of a business is structured on the work to be done and on the human and physical resources to be committed. With the introduction of data base technology, significant changes are likely to be made in data processing activities and thus in those departments which are engaged in informational activities. It is often desirable to restructure the organization in the interests of greater efficiency. Work groups may be realigned; tasks formerly assigned to a number of departments may be eliminated or consolidated in a new single "management information" department; and existing departments may be eliminated or the scope of their operations may be sharply curtailed. Basic changes of this nature require the attention of top executives. An organizational issue of fundamental importance is the extent to which new systems should concentrate or centralize authority and control in the hands of top-level management. The impact of the path chosen on future organizational structure, basic company philosophy and policies, and managerial authority of managers below the top echelons will be great. Organizational decisions of this magnitude require the serious consideration of top executives.

3.2.1 Resistance to Change

The organization manager encounters two sets of pressures. One, from below, is a strong resistance to change. The other, from above, is the pressure to successfully implement the change. In the problem of introducing changes to work methods and rules, the question of timing becomes important. The established manager must consider that fast changes can often lead to violent resistance and disrupt the entire organization. On the other hand, slow changes may invoke some resistance, less intense at any given time. Even the slow change must be clearly communicated to all employees or exaggerated fears and rumors will arise about where the change is leading. Since the problems have been created by change, it is necessary to minimize or eliminate any forms of change that are not absolutely required.

3.2.2 Human Factors in System Development

When a well-designed system fails in one organization, while a similar but poorly designed system succeeds in another, the reason can usually be attributed to human factors. Employees who dislike or, perhaps more appropriately, distrust a system can make a well-designed system fail. Employees who want a system to succeed can usually make it work, even if the system is poorly designed.

The subject of resistance to change has already been addressed. Resistance may also arise as a result of design features which make the system an irritation to the operators or users.

The keys to overcoming resistance are participation and communication. Employees will tend to accept systems they have helped to design because they see the need for the design features. They derive satisfaction from designing a good system, even though it may disrupt some established routines. The participation allows the employee some control over the change and thus increases the employee's security. Communication with all interested personnel will generally assist in reducing unfounded fears which add to resistance.

Job assignments between man and machine should not always reflect processing advantage. Other factors such as the need to

have the human perform an interesting set of tasks should be considered. In other words, tasks which may be performed by the computer may need to be assigned to the human in order to keep him stimulated and alert.

The way humans view their jobs may influence their use of a given information system. Typically, most individuals will tend not to use systems they do not understand. This does not imply the need for a technical understanding of program structure or modular design, but an understanding of the logic of the process they are asked to rely upon. This problem is particularly acute in models for analysis, decision-making, and planning. Often such models are so complex that the user cannot understand why or how the inputs result in the outputs generated. These models will most likely never be utilized. This suggests the need for simple models which grow as more complex features can be accepted by the users.

3.2.3 Motivating Personnel/Minimizing Turnover

The problem of turnover among skilled employees may be as high now as among the unskilled labor force. Locating and training replacements remain time-consuming and expensive activities in many organizations. Furthermore, departmental productivity may suffer seriously because of the departure of key personnel. It is therefore important for managers to keep turnover to a minimum. While psychologists have identified and classified human needs into five basic levels (physiological, security, social, ego, and self-fulfillment) Professor Frederick Herzberg [13] of the University of Utah has made a distinction between those factors that motivate and those that only influence behavior. The motivating factors are those high-level needs such as:

(1) the need to achieve something useful

(2) the need to be recognized for such achievement

(3) the need to have the work itself be meaningful

(4) the need to be responsible for making decisions

(5) the need to grow and advance.

In summary, job satisfaction, high production, and low employee turnover are related to the self-fulfillment of people on the job.

The lower-level physical, security, social, and status needs are sometimes referred to as maintenance factors. According to

Herzberg, the presence of these factors, along with economic and employee-orientation factors, does not necessarily motivate workers because such factors tend to be taken for granted. A manager must, therefore, look beyond the lower-level needs in motivating his staff. These needs must be satisfied, of course, but frequent raises and private offices may not be enough to reduce turnover and produce motivated employees. More likely to be important in achieving these desirable ends are:

(1) the promise of challenging work,

(2) the assignment of greater responsibility to staff members,

(3) the setting of realistic and carefully thought-out objectives, and

(4) the opportunity to grow and develop through such means as carefully planned training programs.

3.2.4 Man/Machine Division of Labor

Rapid technological advances have led to an increasing number of human functions being performed faster, more accurately, and with greater scope by the computer. However, humans have certain inherent advantages. They can reason from incomplete information; they can operate in a trial-and-error environment and can apply the entire range of their experience to problems. At the same time, humans require challenge and variety in their jobs in order to remain motivated. The major issue, therefore, is how to structure the different tasks in a man/machine environment so that the technology is used effectively while a satisfactory job environment for the human factor is still maintained.

3.3 MIS Factors

The development of management information systems has been very rapid. Major developments beginning back in the mid-1960's brought about differences of opinion about how computers should be used in information systems. The early 1970's brought increasingly widespread acceptance of the data base approach along with new problems and new issues with implications for the relationships between the users and the systems personnel. This section identifies these current issues and problems of information systems for organizational use.

3.3.1 System and Data Security

System and data security is not just a conceptual issue. It is a practical problem because the consequences of indadequate security can be quite serious.

The concentration of processing and files in a limited area using a small number of operations personnel increases the risk from fraud, destruction, theft, etc. A continuing problem in information system management is to provide adequate system and data security by such measures as:

- data access security
- special disaster recovery procedures
- off-premises backup for files and programs
- provision for backup processing
- internal and external audits.

Beyond system and data security for the protection against theft, fraud, and deliberate destruction of data is the issue of data provincialism. Users often develop a protective attitude toward data which they feel "belongs" to them. The concept of data-sharing, especially in the data base environment, poses a threat to the security of their departmental operations. The

analyst involved in applications system development will inevitably encounter questions and concerns of the various user groups as issues of data-sharing are brought to light during discussions of data base design.

There appears to exist an on-line/data-base "synergism" that often makes it quite difficult to implement one without the other [19]. The on-line environment presents, of course, additional concerns regarding the issue of security. The potential culprits are not only the designers of the system, but the users of the system as well. Since the users are remote from the system, it is more difficult to use "physical" security methods [15].

3.3.2 Information Quality Control

In a manual system a series of checks and balances is maintained because of the number of people who process documents. The fact that more than one person works on the processing or handles a document adds to the control against unauthorized, improper, or fraudulent transactions. Separate files and separate processing systems localize errors. The redundancy in the manual system often results in similar files being maintained by different parts of the organization. In the event of errors, this redundancy often makes it possible to identify correct data. The integration of processing and the integration of data mean that much of this redundancy is removed. An error which may have been localized in the manual system may now affect a variety of functions because the data item is prepared and processed only once.

Therefore, a major problem in information processing is the upgrading of the quality of input and processing in the information system.

3.3.3 System Responsiveness

The concept of individual dignity suggests that systems be designed to be responsive to the individual. The problem of errors and the nonresponsiveness of systems to correct requests (company billing errors) has resulted in proposed legislation to protect customer rights [3].

Within the corporate environment, the responsiveness of a system becomes an important measure of effectiveness along with the accuracy and consistency of data. User dissatisfaction with a nonresponsive system can result in decreased use, or perhaps even a return to the system's manual or outdated predecessor. System responsiveness becomes even more visible in the on-line/data-base environment.

3.3.4 Processing/Data Integration

Early concepts in organizational information system design called for the "total system" in which the entire information system was designed as a single, unified system [3]. But such integration into the entire system was found to be too difficult and unnecessary, and this approach was abandoned. Instead, the idea of a federation of systems (or a number of large subsystems) has gained currency. The issue, however, is the amount of integration that should be applied to the organizational information system. Integration may occur in two ways--processing integration and data integration. Processing integration refers to the size of the processing subsystem, ie., how many somewhat independent subsystems should be combined for processing purposes. Data integration refers to the combining of files into data bases; again, the issue is the extent to which this data integration should occur.

3.3.5 Future Implications

While the technology in the computer industry has tended to change very rapidly, information system concepts have evolved more slowly. Hardware has become faster, smaller, and less expensive. Storage devices have larger capacity and faster access and are less expensive. Software developments have tended to lag behind hardware. The trend is toward more standard, purchased software because of the quality that can be designed into such systems. Organizations may purchase substantial parts of the software for their systems rather than developing the software in-house.

The system design process has remained very judgmental, and very little use has been made of technology in the design of new applications. Developments in the automation of system design should help to reduce the cost of new system design. Design methodologies are definitely a step in the right direction.

Increased exposure through advertising, periodicals, seminars, etc. has brought hardware and software vendors closer to the user community. In a highly centralized DP environment in which top management supports large MIS capital expenditures and multi-year project development efforts, the temptation for an isolated user to invest in his own computer resources must be carefully evaluated in light of the corporate goals and the MIS long-range plan [17].

4.0 Improving User/DP Relations

The user is perhaps the most important element in the equation for the successful implementation of an information system. It is the user who ultimately determines the success or failure of the system; and as such, the MIS analyst must work with, not for and not against, the user. User/DP relations are, thus, a critical part of the information processing environment.

The purpose of this chapter is to present an investigation into methods for improving these relationships. First, it is important to briefly discuss and evaluate the current MIS environment and then look to what the future holds in the rapidly changing technological environment. The data base approach is given special attention due to its increased use and the significant impact this new technology has for improving user/DP relations.

4.1 Evaluation of Current and Future MIS Environment

To effectively establish and maintain good working relationships between the MIS and user areas of the organization, it is first necessary to evaluate the existing (if any) MIS environment with regard to how users view MIS effectiveness; and then to look to the long term plans of the organization with respect to the direction MIS will be taking in the future.

4.1.1 Users' View of MIS Effectiveness

With regard to MIS effectiveness, users often perceive information systems as failures in the following respects:

1. Information is not timely. Information arrives too late to be of value in planning and making decisions. Therefore, the ability to take corrective action to prevent out-of-control situations is hampered. Part of the problem is due to the inability of older systems to cope with increased paperwork loads.
2. Information is not properly integrated. Potential users may be unaware of the availability of valuable information produced by internal departments and external sources. The information presented to managers is thus not as complete as it could be. As a result, significant past internal relationships are not analyzed; external social, economic, political, and technological factors which influence competitive actions and the business climate are inadequately considered.
3. Information lacks conciseness. Too much detail obscures clarity and prevents managers from focusing attention on those areas of significance which deviate from planned performance.

4. Information is not available in the proper format. Report formats often lack consistency. Analyses are frequently presented in monetary terms when another unit of measure might be more appropriate.
5. Information costs too much to produce. This is especially true when the information is requested infrequently and at different times. Optimum use has often not been made of personnel and available data processing equipment. The financial returns obtained from the information produced frequently does not measure up to returns expected.
6. Information produced is not relevant. Managers receive information they do not need because they are not in a position to take action which will influence the events reported. Relevant information which would assist the managers in recognizing significant external factors and events is generally not available.

To reduce difficulties experienced with information systems, new systems concepts have been developed and can generally be categorized as (1) quick-response systems and (2) broader systems.

Improving User/DP Relations

(1) Quick-Response Systems

Information is time-dependent; it must be collected, manipulated, communicated, stored, retrieved, and presented in a time frame which is appropriate to the problem being considered. Quick-response systems have been developed to increase the timeliness, effectiveness, and availability of business information. Such systems have the following advantages:

1. They allow managers to react more rapidly.
2. They reduce waste in the use of business resources.
3. They permit quick follow-up on creative ideas.

(2) Broader Systems

Better integration of information-producing activities can lead to information that is more complete and relevant. Traditionally, data processing activities have been organized by departments and by applications. Basic data elements were defined and organized differently for each application; thus, the data items were often expensively duplicated (with an increase in the possibility of error) because it was impossible to integrate these facts in meaningful ways. Dissatisfied with such conditions, organizations began looking for ways to consolidate these activities. The solution: data base technology.

4.1.2 Strategic Planning for Information Systems

Today with the proliferation in the techniques and tools of the systems function an undeniable reality, those managers not capable of introducing a more disciplined planning approach into their area of responsibility will be ill-prepared to cope with the rapidly changing era that lies ahead. Systems managers are becoming increasingly concerned with more formalized and disciplined approaches to identifying requirements beyond the immediate future. The complexity of today's information systems, and the increasingly large share of company resources earmarked to support them, underscores the need for a more carefully prepared "road map" to the future. This is especially so because of the long lead times that typify today's large system projects [22].

The information systems long-range plan (LRP) is a master development plan which provides a framework for all detailed information systems planning. In general, the LRP should include [3]:

- organizational goals and objectives
- inventory of current capabilities
- forecast of development affecting the plan
- the specific plan.

The purpose of such a master plan is to provide management with the information necessary to assess information system development and evaluate the impact it will have on overall organization planning. Since all projects cannot be developed and implemented concurrently, priorities must be set. Through the LRP, user management at various corporate levels may be kept informed and better visualize the "big picture". This helps to reduce user dissatisfaction and better improve the MIS relationships with the corporate user groups.

Most organizations have come to recognize that planning must exist on at least two levels: the tactical level to assure that there is sufficient capacity, personnel, and other resources to continue to get the organization's work done; and, at the strategic level, to anticipate future workloads. Typically, the long-range information systems planning horizon encompasses a period of at least five years, with eight and ten year periods not uncommon.

The strategic planning function must address three basic questions [4]:

- What is the technology going to be like over the planning period?
- What changes will take place in the environment in which the organization must operate?
- What are the long-range corporate goals?

Systems planning can be a powerful, competitive weapon, in the sense that it enables an organization to anticipate technological trends at an early stage, and, as a consequence, introduce new technology and develop new systems in advance of the competition. However, such planning must necessarily be done under conditions of uncertainty. Future events affecting the systems plan, whether these be of a technological, environmental, or policy nature, cannot be predicted with complete accuracy.

There are three basic approaches available to an organization seeking to get started in the preparation of a strategic information systems plan [4]:

- establishment of a task force
- employment of an outside consultant
- application of internal staff resources.

Any of these can produce results, and the preferred approach is largely a function of the organizational environment in which the planning must take place. Frequently, a combination of methods can also prove effective. A task force comprised of members drawn from line organizations that are the principal users of information systems products can be a good vehicle for gaining support from users for planning. Consulting assistance in preparing an initial

plan can then be used to migrate control of the planning function to internal company planners.

4.1.3 The Corporate Transition to Data Base Technology

While the preceding chapters presented, in general, the specific issues affecting user/DP relationships and the implications of the changing technology in information processing, it is the primary purpose of this section to view, in somewhat more detail, the impact of a given "change in technology"--the corporate transition to data base technology.

The development of corporate data bases is rapidly becoming one of the most important data processing activities of recent years, and probably will be for years to come. Some of the most impressive corporate growth stories of the generation are largely attributable to the explosive growth in the need for information. Already, as we move to an increasingly information-oriented society, approximately 20% of the U.S. Gross National Product is devoted to the collection, processing, and dissemination of information and knowledge in all its various forms [8].

Given the falling cost of data storage and the increasing capability to transmit data, it is clear that data base technology will have a major part in the industry. It is a formidable task to identify all the data items that are needed for a corporation and to work out where and how they can best be recorded and stored.

According to Martin [9], the data base concept represents more than just a change in software; it also represents a change in management. In order to avoid building "monuments to inflexibility", the decision to use data base technology should not be made casually and requires the involvement of top management. There should be recognition by management that the data base approach is a departure from traditional means of solving data processing problems. The data base method attempts to solve problems that formerly were unsolvable in a conventional DP environment. Within the framework of the long-range plan, management must assess the applicability of the data base technology to the future departmental and corporate goals [19].

Management information systems have begun to utilize technological advances in hardware and software, as well as new techniques for design and structured programming. MIS departments within many organizations have proceeded with the development of departmental long range plans and have adopted system design methodologies. The MIS long-range plan, in many cases, may serve to "crystallize" the need to evaluate the data base approach [22].

Many MIS departments are venturing into the new technology of the data base approach. Through a formal (or sometimes informal) data base evaluation, a careful assessment is performed to determine the amount of stored data redundancy and duplication of transaction

processing in the existing application systems. The identification of tangible and intangible benefits weighed against the criteria for evaluation can lead to the decision by top management within the corporation to proceed with the transition to data base technology. The "big step" to data base technology would be financed through service to "customers" (corporate users of information services). Through specifically defined projects with anticipated large paybacks, the LRP may be used to support significant budget increases [17].

In assessing the role of DBMS's for future data management needs, it is important to first evaluate the potential contribution of data base technology. This could then result in the careful monitoring of the overall performance of a given DBMS within one or several application projects prior to finally committing to data base implementation strategies of a larger scope. Non-DBMS application development would continue during the evaluation and transition period [20].

The transition to data base will more than likely necessitate the establishment of a "data resources management" function. Such a functional unit in the MIS organization will be faced with heavy challenges in establishing data structure standards, access methods, and quality control of data as an important corporate resource [16].

Improving User/DP Relations

With a given posture toward commitment to data base technology in mind, the MIS system designer must broaden his awareness of the implications such a transition has for improving communications with the users. The designer must keep in tune with planned technological improvements within the department's LRP, and thus, consider the future implications of current systems design approaches.

Once DP management decides to initiate a study on the applicability of the data base concept to the corporate and departmental needs, a number of steps are recommended in carrying out this investigation [1].

(1) DBMS vendors should be kept at a distance at this stage of the decision-making process.

(2) Other installations that have implemented the data base approach should be visited to determine how their decisions were developed and documented.

(3) Seminars on basic data base concepts should be attended.

(4) Upper management should be educated on the basic concepts of data base as early as possible.

(5) Within the corporation a familiarity with potential data base applications should be developed. (This would likely come from the long-range plan).

(6) An analysis should be peformed to determine the requirements for data entry techniques to be used in conjunction with the data base software.

(7) The organizational structure of the MIS department must be reviewed to determine the extent of the

reorganization of tasks and responsibilities of the data management function.

(8) An analysis should be performed to determine the impact of data base technology on the DP operating environment. This cost analysis should include upgrades in core, mainframes, operating systems, or the installation of related software facilities, such as data dictionary or directory systems.

(9) It should be determined, if possible, management's plans for either increased centralization or decentralization of the data processing activity.

(10) The decision to use the data base approach should be formally documented.

The real secret of success lies in the systems management of the organization seeking to use data base. Those organizations which are most successful in the use of data base technology are largely those which already have a solid systems building process with which to work. Part of the difficulty involved in using the data base concept is the mythology surrounding the subject. Many organizations make the mistake of neglecting the fundamental problems of systems development and performance in attempting to come to grips with the complexities of data base administration. Data base can be viewed as the aggregation of the data requirements of a number of application systems. Because a data base exists to aid in the production of useful output, and because data which is not correct cannot be used, there should exist no such thing as an integrated data base without integrated applications systems.

4.2 Definition of System Requirements

The purpose of this chapter is to discuss two general concepts - the system design methodology and the service analysis approach - which help to provide for complete and consistent definitions of the requirements of a given information system, thus insuring user and analyst agree on the system requirements, capabilities, and scope.

4.2.1 System Design Methodology

Simply stated, a systems design methodology is a design method with precise decomposition rules which assist in the design and implementation of an information system. A comprehensive systems design methodology should provide a complete logical method for developing effective systems to meet the information requirements of an organization.

A system is composed of business processes made up of procedures containing operational steps and, in most cases, programs. An effective system design methodology must be a means to design complete, well thought-out, effective information systems, not merely the computerized portions [2]. Documentation also plays an extremely important role in the design process. Documentation should be a by-product of systems design; at the end of each phase of design, working documentation should be produced and approved by the user before moving to the next level. In this manner, the user is incorporated into the design process.

The information system is a product; it must be engineered and manufactured like any other product. Design is not unique to the information systems field. Other disciplines such as architecture, manufacturing, engineering, etc., have long addressed the same problem and have arrived at the same logical working solutions -

requirements are determined from an overall perspective and then components are designed by decomposition.

This logical design by decomposition enjoys many benefits. Each level of design:

- provides the specifications and requirements for the next level
- improves communications with the user through working design documentation
- allows for project monitoring and management
- provides for management of resources.

Since the product is engineered to fit together, implementation is made simpler.

Since a systems design methodology is a discipline, it should be independent of techniques used in application. A technique is nothing more than a specific means of executing a procedure that will lead to a desired result. Some techniques are better than others. The problem with techniques in the DP industry is that they often become obsolete as fast as they are introduced, tending to be highly volatile in nature. Therefore, a systems design methodology must remain free of techniques yet allow for their use.

The decision to obtain or develop a systems design methodology should originate from as high up in the MIS hierarchical structure

as possible, because it is a management problem as well as a technical one that the methodology must deal with [2].

The risks and uncertainties associated with building business information systems vary with the size, complexity, and degree of innovation of a project. Major factors affecting user confidence and acceptance of a given system are:

- improperly defining scope and requirements
- incorrectly estimating costs and benefits
- selecting inappropriate technology
- exceeding time and cost constraints.

4.2.2 Data Base Planning Techniques

Within the past several years, the data base approach to data processing has gained widespread acceptance among users in industry, business, and government. Nonetheless, success with data base projects has in many instances proven illusive. A single theme seems to have emerged from past data base failures - that adequate planning is an absolutely essential ingredient in achieving expected data base pay-offs.

Seven basic areas have been identified in which intelligent data base planning is required [14]:

(1) Pre-Data Base Survey

(2) Service Analysis

(3) Data Dictionary Development

(4) Initial Data Base Architecture

(5) DBMS Package Selection

(6) Cost Benefit Analysis

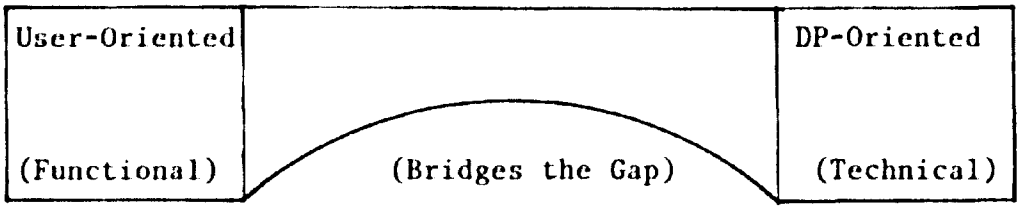
(7) Implementation Strategy.

Notice that DBMS Package Selection is fifth in this list of seven areas or stages. Reason? Only when it has been determined what the specific and individual data base requirements are can a wise decision be made in choosing a package or tool to satisfy the particular set of data needs.

Improving User/DP Relations

Exhibit 3 (page 57) represents the relationships between the user-oriented and DP-oriented areas; the development of the data dictionary and the initial data base architecture serve to bridge the gap from the functional to the technical areas. Heavy user involvement is necessary and user management must recognize the importance of committing sufficient resources from his staff to work closely with the MIS analyst. It is not uncommon for the analyst to spend as much as fifty percent of his time working directly with the user [21]. Particularly beneficial is the use of the service analysis methodology to analyze the corporate information requirements. In order to place service analysis into proper perspective, it is important to understand where it fits among the other areas. Because initial data base architecture, DBMS package selection, cost benefit analysis, and implementation strategy are related to the translation of the established data base requirements into technical criteria, discussions of these areas are purposely omitted since they do not fall within the scope of this paper.

Seven Areas of Data Base Planning



1) Pre-Data Base Survey
2) Service Analysis
3) Data Dictionary Development
4) Initial Data Base Architecture
5) DBMS Package Selection
6) Cost/Benefit Analysis
7) Implementation Strategy

4.2.2.1 Pre-Data Base Survey

The purpose of the Pre-Data Base Survey is to perform a high-level review of the organization's information needs in terms of its general goals and objectives. Top management's involvement in the evaluation of whether any data base system should be used in the business' DP operations is a necessary prerequisite for the actual selection of a particular DBMS package. Management must assess future corporate goals and determine how applicable data base technology will fit in this framework. Managers of user departments and other key people must be interviewed in order to determine how effective data processing is perceived to be and how well it is currently meeting specific needs. Additionally, the professional resources of the DP department should be reviewed to determine what talent and/or deficiencies may exist. Finally, current systems must be analyzed to determine their effectiveness and their cost in terms of on-going maintenance. Once these areas have been examined, it is possible to determine the general corporate direction, and to ascertain whether or not the data base approach fits into the overall picture. If so, a candidate application area is selected and initial service analysis planning can begin.

4.2.2.2 The Service Analysis Approach

The service analysis is a structured approach to the task of requirements definition for a data base system project. It begins with user interviews to determine exactly what they need to perform the functions of their jobs, then continues with an analysis of these needs in terms of the information they provide, and finally concludes with a formal and comprehensive statement of what services the system will ultimately provide [14].

The key to successful data base design lies in identifying the real-time uses to which data base information is being applied. This does not mean looking at existing DP reports; this means going out to the user and finding out firsthand what the user really needs.

This effort can be broken down into three distinct stages. First, users are interviewed so that a thorough understanding of their practices and problems may be obtained. Then, the information collected during these interviews is analyzed so that data needs can be identified. Finally, a statement of comprehensive requirements is created so that these data needs may be translated into terms that lend themselves directly to data base design.

The best way to approach identification of the end user needs is to attempt to break end user functions and processes into the

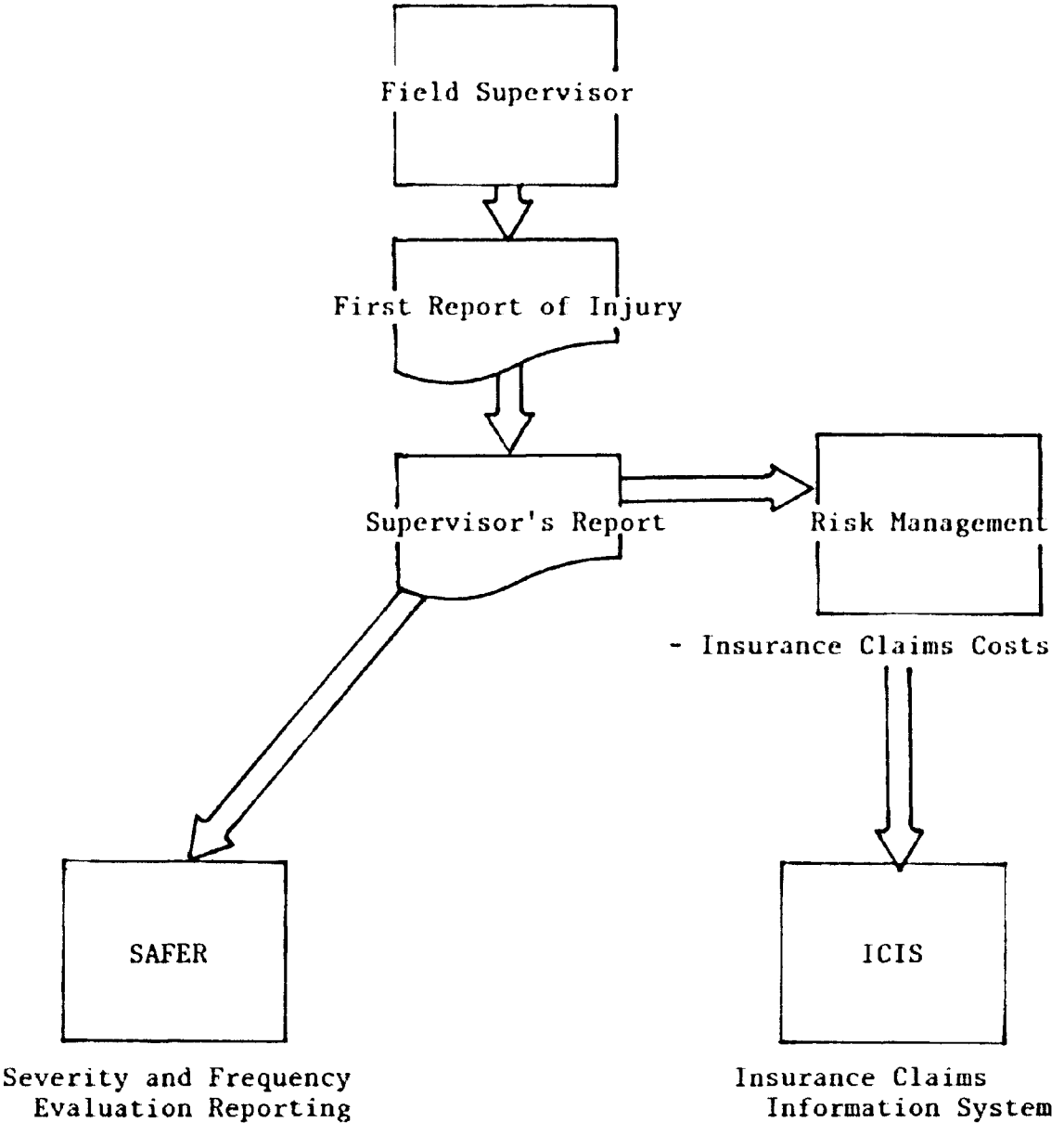
smallest possible units. Such a unit is typically one performed by one person at a single point in time. To reach this level, it may be necessary to divide end user functions a number of times, specifying subfunctions, tasks, and so on. The most basic functional unit is one for which information requirements are completely homogeneous and easily described.

These units or microscopic tasks, called services, may be either computerized or manual. During the initial stages of analysis, service always describes unit tasks performed by individuals. Later on, after substantial analysis and review, service descriptions are transformed into DP services - ie. into informational services to be provided by a computerized system. Exhibits 4 and 5 (pages 61-62) depict the existing and proposed data flows for a corporate safety information system.

The service analysis approach differs from traditional system analysis. In service analysis, the definition of user requirements is disassociated from the design methodology that will be ultimately used to achieve the information solution. From a technological point of view, this approach is sound because data base is technically much more flexible than traditional methods. The service analysis approach has a high probability for success because it focuses on the most important system component of all - the end user.

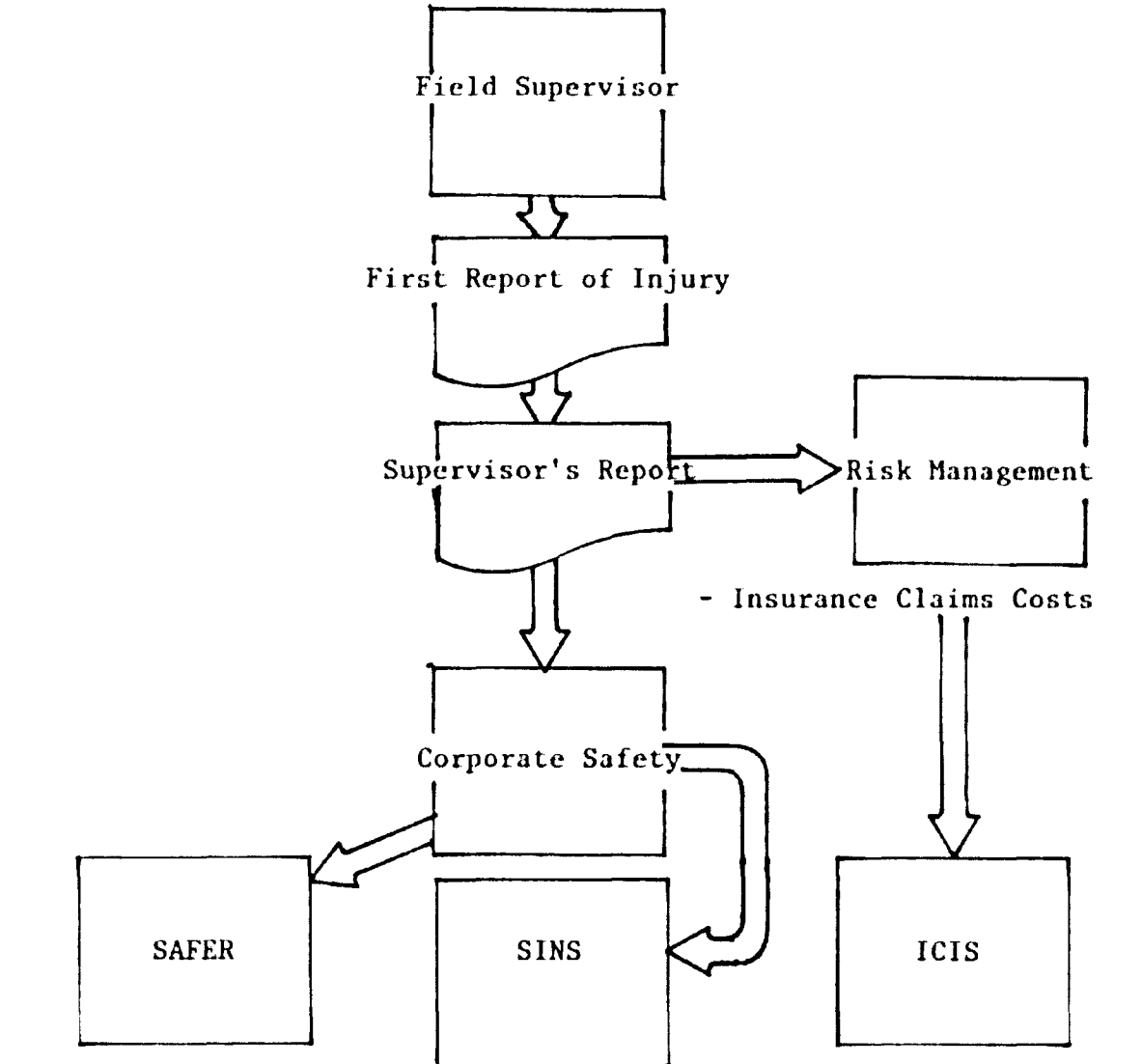
High-Level Flowchart of End-User Processes

(Existing Data Flow)



High-Level Flowchart of End-User Processes

(Proposed Data Flow)



Severity and Frequency Evaluation Reporting

-Obtain SAFER organization data

Safety Information System

-Management Reporting

-Accident Investigation

-Accident Statistical Analysis

Insurance Claims Information System

-Obtain insurance claims costs (total reserve amount)

Any commitment to specific file formats or system design is purposely avoided during the service analysis in order to avoid premature restriction on the outcome of the analysis. Similarly, the future integration of related systems is recognized only within the context of information requirements rather than in terms of specific implementation techniques. Imposing specific interface criteria is impractical until a service analysis is performed for these other systems, and due consideration is given to the data base.

The goal of service analysis is the development of a comprehensive requirements statement, which can be used in data base architecture design. The information contained in this statement will also help point toward a naturally staged implementation plan.

Also, it should first be noted that the development of a data dictionary (to be discussed in Section 4.2.2.3) is intimately associated with the service analysis effort. And secondly, it is not necessary during service analysis to pay particular attention to collecting information for actual application systems design. This type of activity is best postponed until a later time, when the detailed system design effort is begun.

Service Analysis Terminology

The service analysis approach recognizes the existence of certain delivery constraints associated with particular services. These constraints may be inherent to the subtask associated with the service, or they may sometimes arise out of company policy. The limitations of current DP systems, however, are not considered delivery constraints.

Identifying these constraints is an integral part of defining services and then subsequently designing systems so that user requirements are met. Before examining the specifics of the service analysis methodology, it is necessary to define the following terms:

User - Users are the system's clientele, and include managers, operators, accountants, clerks, etc. In general, any person in a given department associated either directly or indirectly with the information problem under analysis is a user.

Client - Clients are the organizational units within which users perform their jobs; for example, the Corporate Safety Department.

Service - The smallest unit of a client's business processes as performed by an individual user at a given point in time is a service. Only after these functional units are described in informational terms do they become services relevant to DP. A DP service is a repetitive system-supported data operation, which is performed by the system as a unit and which satisifies a data query or maintenance need of the user. In actual DP system design, a service usually results in an input transaction or query resolution.

As previously mentioned, the identification of delivery constraints becomes important to the success of the service analysis approach. The following terms are defined as the most basic delivery constraints identified for services:

Frequency - Frequency refers to the number of times that a particular service is performed or requested. In order to be used in meaningful ways, frequency information must be translated to a common denominator so that values can be compared directly between services (ie. services per day, services per hour, etc.). Furthermore, estimates of frequency should reflect fully operational systems including projected growth.

Volume - Service volume refers to the number of logical records that require processing in order to complete the service. Multiplying the frequency of a given service by its volume generally gives a reasonable estimate of the total frequency of data base access involved with that particular service.

Availability - Availability is an expression of the limits of acceptable and satisfactory service turnaround for the user. Availability becomes a key factor in determining whether a service should be on-line or batch.

Service Analysis Interviewing

The execution of a service analysis consists of an interview procedure that revolves around a basic set of informational questions. This set of questions is designed to elicit pertinent information for formulating service descriptions, performance constraints, and certain other key types of information. The central focus of the interview should be the functions performed by the interviewee (user) in satisfying organizational duties. Sample interview results are shown in Exhibits 6 and 7 (pages 68-69).

The following questions are examples of the types of questions which best lead to a formal discussion of methods, rules, problems, and finally, of services [14]:

- What is the most frequent activity of the function?
- What is the most important activity of the function?
- What is the most time-critical activity of the function?
- What is the most error-vulnerable activity of the function?
- What reports are most important in supporting the function and how are these used?
- What source documents are received? Which of these are actually used? What new data is produced? What is the frequency and volume of each of these data activities?
- What plans exist for new or modified procedures?
- What observations can be made about other potential interviewees that use information elements similar to those being discussed?

It is critical to remember that service analysis is essentially a non-DP and non-technical activity.

Sample Service Definition

Service:	Query resolution.
Client:	Corporate Safety Department.
Description:	Ad-hoc request for information retrieval.
Frequency:	10/month.
Availability:	24 hours.
Currency:	N/A
Related Services:	Corporate management reporting.
Current Sources:	Manual.
Key:	N/A
Sequence:	N/A
Data Objects:	Primary accident statistics by categories such as nature of injury, part of body injured, etc.

High-level Management Summary Interview

Most Frequent Activity:

Corporate Management Reporting

Most Important Activity:

Corporate Management Reporting

Most Time-Critical Activity:

Ad-hoc Report Generation

Most Error-Vulnerable:

Data Collection/System Input

Most Meaningful Reports:

Corporate Loss Ranking Report
Incident Cost Summary Report

Existing Source Documents:

Accident Investigation Report

New or Planned Procedural Changes:

Field Supervisor Completes Combination
Accident Investigation Report/SINS Data Input Forms

Potential Interviews (for other data users):

Risk Management
Corporate Medical
Employee Relations

4.2.2.3 Data Dictionary Development

The results of the service analysis serve to document the various ways in which organizational data is used in order to satisfy business requirements. This data consists of a number of individual data objects, each of which may be used in many different services. However, the notes compiled in the service analysis interviews do not provide a central and unique identification of what each of these individual data objects represents. Therefore, the next logical step in data base design is uniquely defining the data objects that constitute the data used by the organization.

This is where the data dictionary can play an important role. By providing a systematic means of documenting data objects, the dictionary can assist in ensuring uniqueness and consistency of definition [18].

The information collected during the service analysis serves as a natural starting point for the development of a data dictionary. The data dictionary can be viewed as providing a directory service to corporate information resources regardless of what form those resources may take. The business of data processing is to produce the type of information that satisfies the users' needs. Too often, however, because of inadequate documentation, redundancies in files and reports, and ineffectual documentation strategies,

it becomes difficult to determine just what data is available, how it is produced, and where it actually resides. A common problem is that information about data is often system-bound, rather than being accessible on its own. A data dictionary can be expected to provide independent information about data, unlimited by such constraints.

The application of certain analytical techniques can be applied against the service analysis data, such that definitive patterns of usage and relationships are suggested. This information leads naturally to a preliminary or "logical" data base architecture, which can then be tested against user requirements as defined by the service analysis.

It is also important to note at this point that service analysis becomes the crucial prelude to effective data base system design. The systems designer must become familiar with the business life of the organization, in order to see where and how information is used. In order to accomplish this, he must be able to communicate with users in terms that both can understand. Service analysis provides the general guidelines that can assist in these efforts.

4.3 Data Analysis

Analysis can be viewed as the examination of a real world problem - creating a structured description of what the problem is so that it can be attacked in an organized way. This description is the requirements definition or functional specifications. The next step is to design a model of the system that will solve the problem. Then, through the application of structured programming techniques, the designer creates a general statement of the system, which is progressively broken down and refined - top-down system design, or, structured design.

One of the basic motivations of design is to break down that which is to be built into manageable parts so that the building of those parts can be assigned to different individuals or teams. But the parts must fit each other, be able to work together when put together. And by starting at the top and progressively refining the design, it can be assured that the parts will mesh--that their substructures are clean, their interdependencies clear-cut. The major advantage to structured design is that the big picture is always clear.

4.3.1 Logical Data Structuring

In the past few years, we have begun to see the impact of "data structured" systems design at the programming level and at the systems level. We now see the impact that "structuring data" is apt to have throughout the organization. A logical systems and data base design represents a major breakthrough. The same tools which are helping us attack complexity in programming and systems design are now beginning to have a significant impact on the design and development of integrated data bases as well. "Structured data bases" are a natural outcome of "structured" systems design [10].

4.3.2 Logical Output Structures

Each output of a system has its own characteristically logical, hierarchical data structure. This is true even of such things as outputs for on-line or real-time systems, though, in these cases, it may take more effort to find these structures. Each logical structure represents an individual access path provided by the logical data base of the system. These logical structures, in conjunction with the computation and decision rules, represent the basis for the entire logical data base design process.

In order to define the total data requirements for an entire system, the most effective approach is to group those individual access paths together into a single hierarchy, first by frequency of access, and, secondly, by priority within frequency. At a systems level, these frequencies usually represent something like day, week, month, quarter, etc.

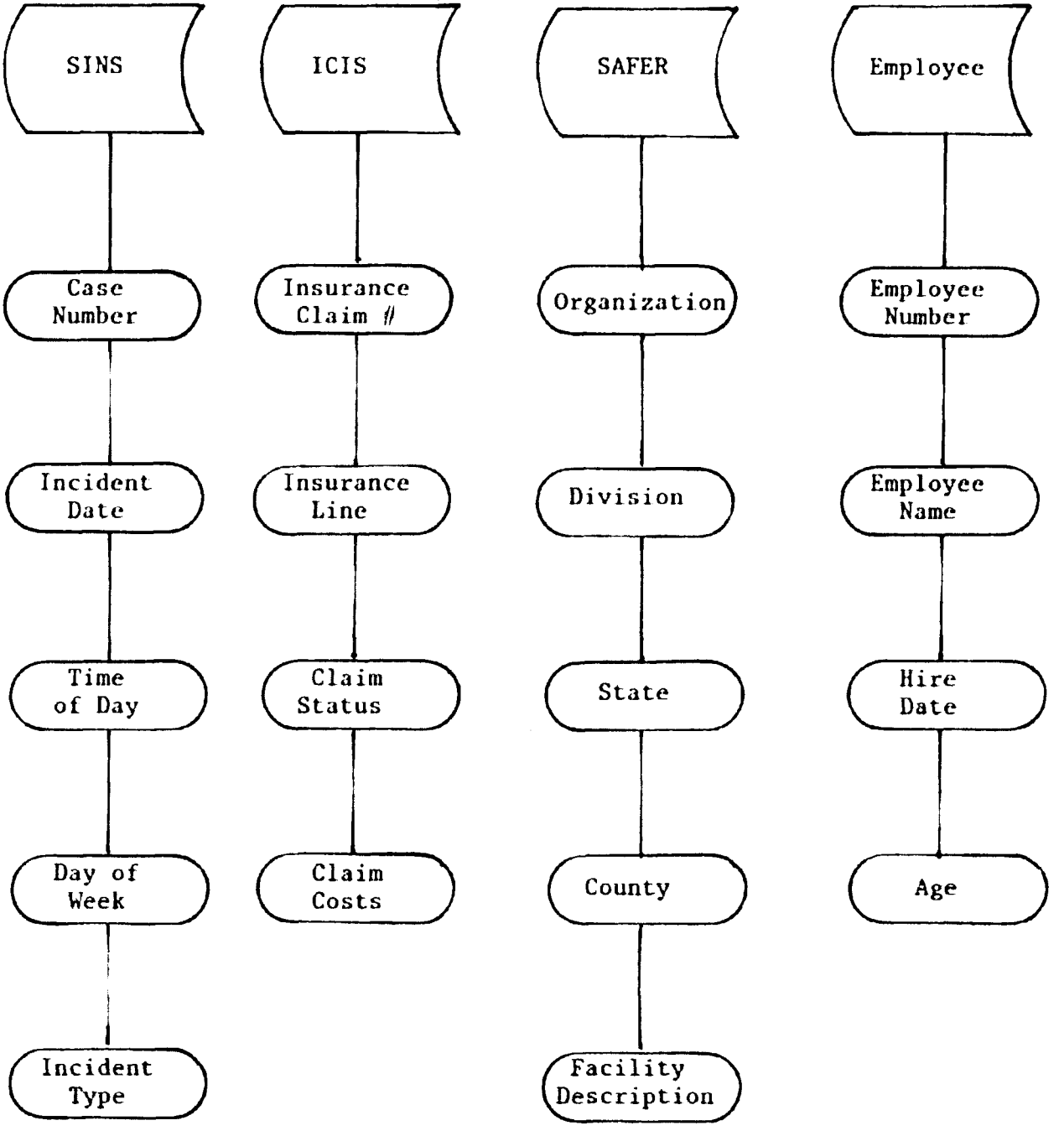
In addressing the logical data base in light of frequency of access, it is possible to identify directly those information requirements which can be met only by high speed direct access, and those which can be satisfied by some slower and less costly process such as batch processing, or even, in some cases, manual processing.

From the logical data base, it is possible to factor the logical data base into a set of "logical basis files" [11] - ie. the minimum set of independent data files by which one can be certain of producing a given set of outputs (see Exhibit 8, page 76).

In the past few years, a number of data base researchers have begun to argue for the definition of logical data in terms of an "entity-relationship" model. This model is based upon the idea that a stable data base should optimally model the real world, and that, in doing so, it should consider those entities which exist in the real world, as well as the relationships which exist between them. The better the data model, the better and more stable the systems design, and the more complete and adaptable the systems. Additionally, the concepts applicable to program and systems design, such as logical structuring and hierarchical definition, become relevant to data organization as well as to the organization of programs or systems.

Associated with each logical basis file, and with each logical data element of each logical basis record, there should exist, in the real world, one or more events which can affect that type of entity, relationship, or element. Some of these events are of importance to the logical data base, while others are not. By examining each logical basis file and the associated logical elements, it is possible to determine the rules for logical

Logical Basis Files



updating of the data base. The logical updating rules ensure two things: completeness and consistency. Event analysis can help to ensure that the systems designs are complete since it forces the analyst and the user to define all of the external events of which the system must be knowledgeable.

The logical inputs to a system are then the by-products of logical data base design. Any data item which eventually is placed on the system output, or which affects something on output and is not calculated, must be input. By approaching data base design from the output, the design follows in which all the major pieces fit together in a systematic, coherent manner in which each element has a natural place. By working in this fashion, all of the difficult questions are addressed first, and the work proceeds on progressively easier tasks, until, at the end, there are no decisions left to be made - simply obvious choices.

4.4 Obtaining User Involvement

Often there is a "we/them" relationship between the systems analyst and the management and users for whom the systems and applications are designed. Thus, the organization does not obtain the potential benefits from its investment in information systems. This section attempts to examine some of the underlying causes for user management concern and identify methods for developing and maintaining user involvement.

4.4.1 Minimizing System Complexity

It would really be convenient if the system designer could just define data and let the output take care of itself. Unfortunately, that just doesn't happen. In many cases, the user doesn't know what he wants, or what he needs, and the analyst doesn't know how to help him find out. But the fact remains that the only way to build a correct system is to start with an exact logical specification of the output.

Frequently, information systems, as opposed to transaction processing systems, are built around fairly sophisticated models that are used to generate information. Many times these models force users to structure their thinking in ways to which they are unaccustomed. Additionally, a substantial amount of "front-end" work must be done to prepare inputs to properly use the information. The quantity may be such that it would be easier and quicker to do the work manually than to use the automated system.

Another way in which users must deal with complexity is in the fact that most systems are designed to handle the norm, but not the exception. So, when unknown or unanticipated problems arise, even more standards and conditions must be added to the system, making it appear even more complex.

4.4.2 Improving Data Accessibility

Managers who have become accustomed to using information systems often request to have reports prepared based on data which they know is in the files of the system. Since the data is already collected and stored and, furthermore, is in machine-processable form, they see no reason that it cannot be used to prepare a strategic report. But upon making such a request, the user is informed that even though the data exists in the system, it is not accessible - it is scattered over several different files. To access it means that the files would have to be reorganized and the reprogramming would take several weeks. This situation is not uncommon, and repeatedly, user management suffers a set-back in their expectations and their confidence in the system is shaken. Users don't understand and refuse to accept the explanation of why data that they know is stored cannot be accessed. The possibility then exists that they will be tempted to revert to their manual files to assemble the report that is needed.

Another constant fact of life in information systems is change. Few applications are not going to undergo modification in the near future, either because of changes in the user's view or because of improper data structuring in the design. Many critical systems are characterized by complex interdependencies and processing methods.

And the greater the amount of complexity, the more difficult it is to modify systems to fit the user needs. This further limits accessibility.

4.4.3 Defining User Requirements

Today's managers must not only structure the problems they are facing, but also the information they receive to deal with these problems. Often the systems analysts, not being in management roles themselves or unfamiliar with the business, do not fully understand the dynamics of the situation in which the information will be used. Since the analysts are not certain what information is required, how much detail should be included, or what formats should be used for reporting, the resultant system design may call for giving the user all or most of the information believed to be needed. Furthermore, the information is presented in a highly detailed fashion, the rationale being that managers can always derive the summary from the detail, but not vice versa.

It should be possible to have the system help the users by providing precisely what they want rather than causing them additional work. The specific information needs must, of course, come from the user. Analysts cannot design in a vacuum. One of the underlying causes of the problems discussed thus far is a lack of meaningful and useful tools. The increased use of data base management systems is vastly improving the situation by making it possible to structure data needed by individual users independently of how or where the data is stored. Use of DBMS also facilitates

early user involvement and allows adjustments to the system, further tailoring it to the users' needs. Most information systems have been designed to be process-oriented rather than user-oriented. The systems designer needs to take to heart a basic guideline: fit the system to the user, not the user to the system.

4.4.4 Developing User Interaction

Given that the user is often unable to define exactly what he expects from the system only makes the definition of the output of the system that much more important. Practical experience indicates that productivity in systems work is highly correlated with the degree to which the user can define what he wants out of the system. One author suggests the futility of user involvement and stresses "interaction" rather than "involvement" [6]. Involvement tends to be passive; interaction, on the other hand, is active with a continuing stream of participation by all concerned individuals. Interaction focuses attention to the best information solution that will help the user make better business decisions. As previously discussed, the educated user is the key to improved user interaction. Through the use of special seminars and workshops directed toward helping the user understand and participate in the design process, the organization can best reap the benefits of its informational assets.

4.4.5 Improving User Communication

During the last few years, the experimentation and development continued in the process of structured systems design, which involves working systematically backwards from the output to the data base required to produce the correct outputs, to the inputs required to maintain the data base. This research has yielded some tremendous insights into more productive ways of building useful and usable information systems.

Human beings have a limited ability to imagine something that they cannot see, feel, or touch. By giving the user something he can relate to, a common point of reference can be established. The process of developing simulated outputs can seem expensive, but getting the user to make his changes, or voice his discontent before the system is designed is considerably less expensive than it is when the system is in testing.

What analysts and their users have discovered is that the users have not understood the systems analyst and programmer, and vice versa. What output means to the analyst and what it means to the user are often different. When the analyst defines output, he usually does so in data processing terms. This, expectedly, creates some problems in communications.

This is another reason for the underlying information system development problems. This may, in fact, be the most basic and most crucial factor causing the problems. Lack of communication may translate into lack of control. We are accustomed to having communication and control in the form of performance standards, acceptable quality levels, and means for measuring performance, comparing it to standards, and providing feedback to change performance in the functional areas of business. However, in the systems area we have few, if any, concrete standards for communication and control of performance across the systems group/functional area boundaries.

This communication problem highlights the need for new tools with which to get the user involved and committed early in the definition process. Increasingly, the system design process has come to concentrate on the logical definition of the output to assist in the definition of user requirements. Two basic tools recommended in this area of structured systems design are the logical data layouts and the Warnier-Orr data diagrams [12]. Both tools are simple, but useful; they simply require the careful definition of the required data in logical terms.

The following two sections present specific examples of the various tools and techniques introduced in this discussion of data analysis as they were applied in the design of a corporate safety information system.

4.4.5.1 Logical Data Layouts

The logical output layout does not define the physical columns and rows in which the data is placed, but rather the logical relationship of information on a page or screen. This seems to be a particularly useful means of communicating the relationships the user will see on the system's output in a way he can easily understand. It also produces information for data base analysis that is easy to deal with and has proven useful to help the user know what he is getting through simulation of the system output. In a batch environment, this means a mock-up using realistic data; in an on-line environment, it means developing realistic mock-ups and displaying them on a terminal screen. Obviously, the more realistic the output, the more involved the user will become.

Exhibit 9 (page 88) is an example of a logical output layout - a mock-up of a safety ranking report for corporate management.

REPORT NUMBER A3DXXX — SAFETY INFORMATION SYSTEM — DATE: DD MMM YY

(SAFER REPORT LEVEL) — LOSS RANKING REPORT* — PAGE: 011

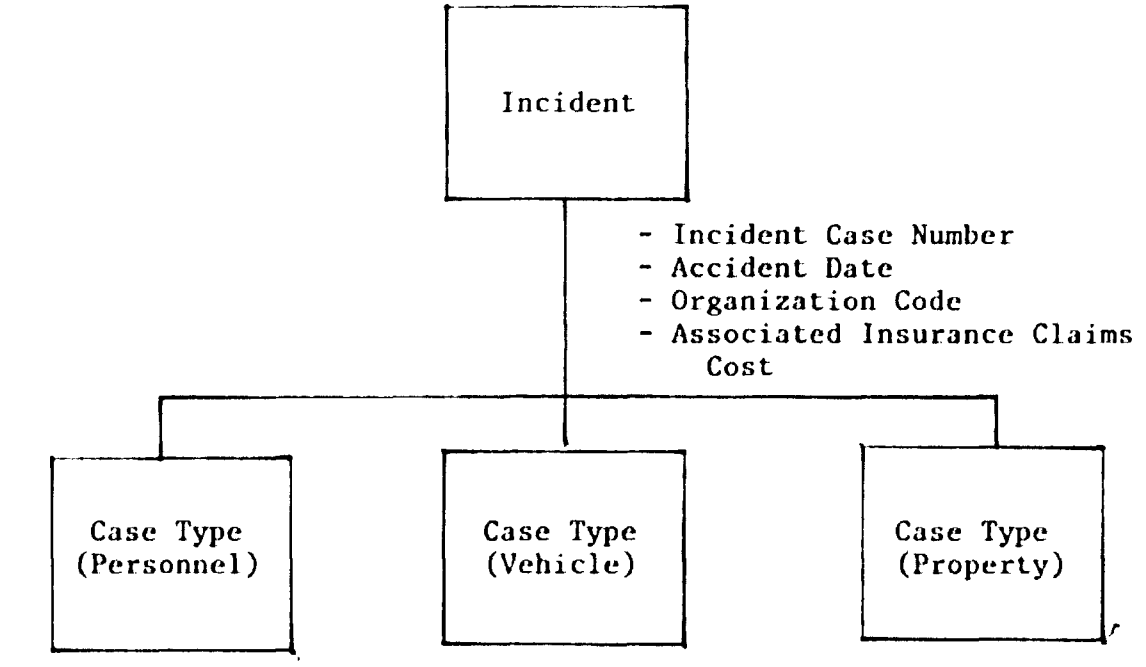
		***** CASUALTY LOSS ***** (INCLUDES EXCESS LOSS)				***** PROPERTY LOSS *****				
			*** LIABILITY ***			*** PLANT AND EQUIPMENT			*** FLEET ***	
	TOTAL RESERVE AMOUNT	WORKMAN'S COMPENSATION	GENERAL	PRODUCT	AUTO 3RD PARTY	FIRST AND EXT. COVERAGE	BOILER AND MACHINERY	BLOCK/ OTHER	DISTRIB	SALES
ORGANIZATION NAME	$----------$	$----------$	$-----$	$-----$	$-------$	$----------$	$--------$	$----$	$-----$	$---$

4.4.5.2 Warnier-Orr Data Diagrams

The Warnier-Orr data diagrams are used to show the hierarchical-logical structure of the output. This is extremely important because of the number of logical possibilities which exist for a complex structure. Often what is seen of the output structure on the layout is merely the tip of the iceberg. The Warnier-Orr diagram helps communicate completely and logically what is intended by the user, and helps him understand the data relationships that support what he will actually receive on system output. Exhibit 10 (page 90) represents the inherent logical data structure supporting the sample report shown in Exhibit 9.

The methods presented in this section are only a few among the many that are available. Those discussed here were chosen for their simplicity and their logical representation of the data in terms easily understood by the users.

Warnier-Orr Data Hierarchy Diagram



- Name of Injured
- Employee ID
- Job Title
- Birth Date
- Age
- Sex
- Social Security No.
- Part of Body
- Nature of Injury

.
.
.

- Vehicle Type
- Accident Type
- Name of Driver
- Employee ID
- Employment Date

.
.
.

- Equipment Type
- Accident Type

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.
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5.0 Summary

The need to put information to use has become critical in the business world. Management needs information to serve its decision-making processes. This need dictates that systems must move away from "data processing" and move towards "information processing". This means changes--changes in management thinking at all levels as well as changes in approaches, in definitions, in responsibilities. These changes inevitably create problems which can either directly or indirectly affect the internal working relationships between the corporate users of information systems and the MIS staff responsible for developing and supporting these systems. Such problems must be addressed on two levels - one, by corporate management and, on a somewhat more detailed level, by the MIS organization.

Problems Confronting Corporate Management

There can develop a widespread pattern of discontent among the users of information systems, in which an "iron curtain" separates users from the MIS practitioners. Therefore, the major problem confronting corporate management is to help bridge the gaps in understanding, communication, and planning. Corporate management must seek to insure that the resolution of these critical

issues can occur in the best interests of the corporation, the users, and the MIS personnel. User management and information systems personnel must work together to understand the responsibilities and unlock the pent-up potential of information systems.

As a concept, MIS should be viewed as an integral part of a business process. It should not be viewed as one single system or independent technical capability. Rather, the overall MIS structure within an organization should be viewed as an integral part of the general operating/business environment it must support, adequately reflecting the interdependencies and interactions of all internal organizational components. Although this conceptual view is a relatively simplistic approach, the actual meeting of the management information requirements for an organization can be a complex undertaking. This complexity is compounded by other such critical factors as the possible geographic dispersal of operations, varying internal organizational objectives and orientations, and continually changing specific information needs.

Management must often operate with insufficient information. And frequently, the more important the decision, the greater the uncertainty. Accordingly, it is important to realize that part of our information crisis results from the nature of the present business environment. Therefore, it is of critical importance for corporate management to recognize the managerial implications, as

well as the economic, organizational, and societal implications, brought about by technological change in the information processing environment.

The information systems of an organization represent the central nervous system of the organization. If the system fails to function, then the entire organization is in trouble. The cost of good information is extremely high, but its value is equally high. MIS should be regarded as more than simply another service organization. MIS is an organization through which one manages the corporation's fundamental, vital, and most valuable resource - data!

The increased use of management information systems in an organization has managerial implications which go far beyond the mere acquisition of computer hardware. Information processing can improve planning and control by providing effective information which:

- leads to problem awareness,
- supports problem analysis and selection of alternatives,
- influences the choice of the most appropiate option,
- permits feedback on the implementation of decisions.

Summary

Problems Confronting the MIS Organization

Beyond the challenges to corporate management, the rapidly changing technological environment in information processing presents problems within the MIS organization. Many corporations are changing very rapidly, but their information systems are often not keeping pace. To some extent, this can be attributed to the inability of the DP staff traditionally responsible for information systems to react to change. Many individuals who were once perfectly adequate in a relatively static situation become ineffective in a dynamic situation. Traditional systems approaches required that the analyst and the user sit down and determine "precisely" what the user wanted, and for what purposes was it needed. In many cases, this has led to narrowly defined systems in which new requirements often meant redesign.

In many cases user management suffers not from a lack of information, but from an excess of information, much of it wrong or misleading. If the MIS organization is to avoid creating a new generation of management "misinformation" systems [11], the focus must be upon the quality of the data which is put out.

An MIS organization which does not perform long-range systems planning cannot narrow the possibilities sufficiently to fit within the immediate future systems possibilities. Given the vol-

atile technological and economic environment in which all firms must operate, it seems doubtful that there are many organizations in which strategic planning is not warranted. Given the volatile state of information systems technology, the plan probably should be revised at least every three years. And, of course, major changes in company organization and operations would require updating the plan independent of technological factors.
Some form of project prioritization may be appropriate for budgeting as well as longer range planning. Here, MIS management might require the users to rank their project proposals on the assumption that funding might not be available for all projects. In a decentralized environment, priorities may have to be established by the central management staff based upon a review of all divisional project proposals. With increasing terminal usage for interactive problem solving and information retrieval by end users, decentralization is likely to become more prevalent.

The Data Base Decision

To illustrate the types of problems confronting both corporate management and the MIS organization, a brief examination of the data base decision is provided.

Summary

The decision to utilize the data base technology should not be made casually and requires the involvement of top management. High-level corporate and DP management should provide a commitment to the analysis of whether this technology is applicable to the business' needs. To do so requires providing the proper amount of time and resources. There should be a formal project with manpower dedicated on a full-time basis to evaluating and reaching this decision. And importantly, enough money must be allocated for educational resources which are essential to the decision-making process.

It has often been said that experience is a great teacher. The corporate transition to data base technology is an excellent example of this. In the pre-data base survey phase, it is extremely advantageous to seek out other installations that use data base software and solicit documentation on how their evaluations were performed. Additionally, it is important to determine what resource requirements were necessary to make their data base management system a productive facility. The key ingredient to a successful evaluation of the data base approach lies in its organization and thoroughness.

The data base concept in itself is not the solution to the problems of effective data management. What is seriously needed is the application of structured data base thinking. When organ-

izations develop correct approaches to defining systems, they get a good data base design as a by-product. Recent trends indicate that the separate worlds of data base design and systems theory have begun to come together. Perhaps the most difficult thing to accept is that the move into a data base environment means data processing and its users must accept discipline in the systems cycle. In addition, the organization involved will have to spend more time in design - management included. In other words, they will have to look at information systems as a capital investment, one which requires planning, forecasting, design, development, and testing. This has always been true of information systems; it simply becomes more apparent in a data base environment.

Form follows function. Data base design is moving from an art to a science, much in parallel with programming and systems design. There are design approaches which tell how to integrate data and systems, assuming the right kinds of information about the system requirements are available. And with the application of techniques such as the service analysis approach, the definition of system requirements should become a more structured and meaningful function of the system design activity.

Guidelines and Conclusions

DP management must be ambitious in setting the departmental goals for achievement, but realistic in making the promises. And in order to assure that what was promised is, in fact, delivered, experience provides the following guidelines:

- Ensure that the system being built is molded to meet the users' objectives.
- Ensure that the DP staff does not assume the responsibility for building the system all by themselves - insist on meaningful user involvement.
- Ensure that the required user involvement is agreed upon before any work on the system takes place.
- Ensure that the user involvement is active, not passive, and maintained throughout the development of the system - stress "interaction" rather than "involvement".
- Ensure that the DP staff, not the user, are the ones who alone define the best methods (from technical considerations) of implementation.
- Ensure that schedules are realistic and accurately reflect not only the staff's ability but also that of the user to participate in development and to properly absorb and utilize the new system.
- Ensure that the staff understands the importance of observing commitments but not at the expense of system quality.
- Ensure that user management is constantly informed about their project and that the communication channels are kept open at all times and that all communication between DP and the user takes place in a language that both understand.

Summary

Through the application of guidelines and techniques presented in this text, the analysts and users can establish and maintain good working relationships which should promote the design and implementation of successful, high quality information systems.

BIBLIOGRAPHY

Books and Articles

1. Adam, Robert G., "Creating the Environment for a DBMS Decision", Infosystems, vol. 24 (May 1977), pp. 62-65.

2. Bryce, Tim, "Evaluating a Systems Design Methodology - Part II", Infosystems, vol. 24 (January 1979), pp. 58-60.

3. Davis, Gordon B., Management Information Systems: Conceptual Foundations, Structure, and Development. New York: McGraw-Hill, Inc., 1974.

4. Head, Robert V., "Strategic Planning for Information Systems", Infosystems, vol. 25 (October 1978), pp. 56-54.

5. Katch, David, "Bridging the MIS Gaps", Infosystems, vol. 25 (July 1978), pp. 56-60.

6. Kneitel, Arnold M., "The Futility of User Involvement", Infosystems, vol. 25 (November 1978), pp. 92-95.

7. Marinaccio, Jr., Michael J., "MIS: The Concept", Infosystems, vol. 24 (Semptember 1977), pp. 89-90.

8. Martin, James, Computer Data-Base Organization. Second Edition. New Jersey: Prentice-Hall, Inc., 1977.

9. Martin, James, "Corporate Data Base Strategy", Video-taped interview, Deltak, Inc., 1979.

10. Orr, Kenneth T., "Antidote for Data Base Disease", Infosystems, vol. 24 (July 1977), pp. 56-58.

11. Orr, Kenneth T., "Procedures for Structured Data Base Design", Infosystems, vol. 25 (July 1978), pp. 78-82.

12. Orr, Kenneth T., "Start with the Output", Infosystems, vol. 24 (October 1977), pp. 86-88.

13. Sanders, Donald H., Computers and Management in a Changing Society. Second edition. New York: McGraw-Hill, Inc., 1974.

14. Shah, Arvind D., Service Analysis Handbook. Performance Development Corporation, Princeton, New Jersey, 1978.

15. Yourdon, Edward, Design of On-Line Computer Systems. New Jersey: Prentice-Hall, Inc., 1972.

Other Sources

16. Air Products and Chemicals, Inc., Allentown, Pennsylvania. Personal interview with Mr. C. R. Bruno, Manager, Data Resources, February 11, 1980.

17. Air Products and Chemicals, Inc., Allentown, Pennsylvania. Personal interview with Mr. L. C. Claitor, Manager, Management Information Department, February 13, 1980.

18. Air Products and Chemicals, Inc., Allentown, Pennsylvania. Personal interview with Ms. D. M. Jacobs, Administrator, Data Dictionary, February 6, 1980.

19. Air Products and Chemicals, Inc., Allentown, Pennsylvania. Personal interview with Mr. R. Krikorian, Senior Data Base Analyst, February 8, 1980.

20. Air Products and Chemicals, Inc., Allentown, Pennsylvania. Personal interview with Mr. P. W. C. Mather, Assistant Manager, Management Information Department, March 1979.

21. Air Products and Chemicals, Inc., Allentown, Pennsylvania. Personal interview with Mr. V. S. Romano, Project Manager, Tank Inventory Data Base Project, January 25, 1980.

22. Air Products and Chemicals, Inc., Allentown, Pennsylvania. Personal interview with Mr. J. C. Schulter, Manager, Long Range Planning, Management Information Department, February 6, 1980.

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